What is claimed is:

1. A method of detecting a positioning error of an electric component with respect to a suction nozzle by which the electric component is held by suction under a negative pressure, comprising:

a first image-taking step of concurrently taking an image of said suction nozzle and an image of at least one dog disposed in the vicinity of said suction nozzle; and

a first data processing step of processing image data representative of said images of said suction nozzle and said at least one dog which have been taken in said first image-taking step, and obtaining and storing a relative position between said suction nozzle and said at least one dog;

a second image-taking step of taking an image of said electric component held by said suction nozzle and an image of said at least one dog; and

a second data processing step of obtaining said positioning error of said electric component with respect to said suction nozzle, on the basis of image data representative of said images of said electric component and said at least one dog which have been taken in said second image-taking step, and said relative position between said suction nozzle and said at least one dog obtained in said first data processing step.

2. A method according to claim 1, wherein said first image-taking step comprises a step of rotating said suction nozzle at least once and taking images of an end face of said suction nozzle placed in at least two angular positions thereof, and said first data processing step comprises a step of obtaining an axis of rotation of said suction nozzle on the basis of the images of said end face of said suction nozzle in said at least two angular positions.

3. A method according to claim 1, wherein a plurality of dogs are provided, and images of said plurality of dogs are taken in said first image-taking step, and an inclination of

an imaging area in which said images of said dogs are formed is obtained on the basis of a relative position of said plurality of dogs in said first data processing step.

4. A method of obtaining relative positions of a plurality of sections of an electric-component mounting system wherein an electric component is held by suction by a suction nozzle under a negative pressure and is mounted on a circuit substrate, said plurality of sections influencing an accuracy of mounting of said electric component on said circuit substrate, comprising:

a first image-taking step of operating a first image-taking device to concurrently take an image of said suction nozzle and an image of at least one dog disposed in the vicinity of said suction nozzle;

a first data processing step of processing image data representative of said images of said suction nozzle and said at least one dog which have been taken in said first image-taking step, and obtaining and storing a relative position between said suction nozzle and said at least one dog;

a second image-taking step of operating said second image-taking device to concurrently take an image of a fiducial chip as held by said suction nozzle and an image of said at least one dog;

a second data processing step of obtaining a positioning error of said fiducial chip with respect to said suction nozzle, on the basis of image data representative of said images of said fiducial chip and said at least one dog, and said relative position between said suction nozzle and said at least one dog obtained in said data processing step;

a chip-mounting step of moving said suction nozzle and a circuit-substrate support device supporting said circuit substrate, relative to each other, and placing said fiducial chip on a mounting surface which is disposed immovably relative to said circuit-substrate support device;

a third image-taking step of operating a second image-taking device to take an image of said fiducial chip placed on said mounting surface; and

a third data processing step of obtaining relative positions among said suction nozzle and said first and second image-taking devices, on the basis of image data representative of said image of said fiducial chip taken in said third image-taking step,

wherein said fiducial chip is placed on said mounting surface in said chip-mounting step after a relative position between said suction nozzle and said circuit-substrate support device is compensated for said positioning error of said fiducial chip with respect to said suction nozzle which has been obtained in said second data processing step, or said relative positions among said suction nozzle, and said first and second image-taking devices are obtained in said third data processing step, on the basis of said positioning error of said fiducial chip obtained in said second data processing step, as well as said image data representative of said image of said fiducial chip taken in said third image-taking step.

5. A method of mounting an electric component on a circuit substrate, comprising:

a method of obtaining relative positions of a plurality of sections of an electric-component mounting system, as defined in claim 4;

a fourth image-taking step of operating said second image-taking device to take an image of a fiducial mark provided on said circuit substrate supported by said circuit-substrate support device;

a fourth data processing step of obtaining a positioning error of said circuit substrate on the basis of image data representative of said image of said fiducial mark taken in said fourth image-taking step;

a fifth image-taking step of holding said electric component by said suction nozzle, and operating said first image-taking device to take an image of said electric component held by said suction nozzle; and

a component-mounting step of compensating the relative position between said circuit-substrate support device and said suction nozzle, on the basis of image data representative of said image of said electric component obtained in said fifth image-taking step, said relative positions among said suction nozzle and said first and second image-taking devices, and said positioning error of said circuit substrate obtained in said fourth data processing step, so that said electric component is mounted at a predetermined position on said circuit substrate.

6. A recording medium storing a control program for practicing the method according to claim 1, such that said control program is readable by a computer.

7. A recording medium storing a control program for practicing the method according to claim 4, such that said control program is readable by a computer.

8. A recording medium storing a control program for practicing the method according to claim 5, such that said control program is readable by a computer.

9. An apparatus for obtaining relative positions of a suction nozzle, a first image-taking device and a second image-taking device, in an electric-component mounting system wherein an electric component is held by suction by said suction nozzle and is mounted on a circuit substrate supported by a circuit-substrate support device, said first image-taking device being operable to take an image of said suction nozzle in a direction of extension of a centerline of said suction nozzle, and said second image-taking device being operable to take an image of a fiducial mark provided on said circuit substrate, said electric-component mounting system further including (a) a component supply device for supplying said suction nozzle with said electric component, (b) a relative-movement device for moving said

component supply device, said suction nozzle and said circuit-substrate support device relative to each other, (c) a component-mounting control device for controlling said relative-movement device and said suction nozzle such that said electric component received by said suction nozzle from said component supply device is mounted at a predetermined position on said circuit substrate supported by said circuit-substrate support device, and (d) a data processing device for processing image data representative of said images taken by said first and second image-taking device, said apparatus comprising:

at least one dog located such that an image of each of said at least one dog can be taken by said first image-taking device, together with said image of said suction nozzle;

image-taking control means for controlling said first image-taking device to concurrently take said images of said suction nozzle and said at least one dog, and to concurrently take an image of a fiducial chip held by said suction nozzle and said image of said each dog;

positioning-error obtaining means for obtaining a relative position between said suction nozzle and said at least one dog, on the basis of said images of said suction nozzle and said at least one dog which have been concurrently taken under the control of said image-taking control means, said positioning-error obtaining a positioning error of said fiducial chip with respect to said suction nozzle, on the basis of said images of said fiducial chip and said at least one dog which have been concurrently taken, and said relative position between said suction nozzle and said at least one dog;

fiducial-chip mounting control means for moving said suction nozzle and said circuit-substrate support device, and placing said fiducial chip on a mounting surface which is disposed immovably relative to said circuit-substrate support device;

fiducial-chip imaging control means for operating said second image-taking device to take said image of said fiducial chip placed on said mounting surface; and

relative-position obtaining means for obtaining relative positions among said suction nozzle and said first and second image-taking devices, on the basis of image data representative of said image of the fiducial chip, wherein said fiducial-chip mounting control means is operable to compensate a relative position between said suction nozzle and said circuit-substrate support device for said positioning error of said fiducial chip with respect to said suction nozzle before said fiducial chip is placed on said mounting surface, or said relative-position obtaining means is operable to obtain said relative positions among said suction nozzle and said first and second image-taking devices on the basis of said positioning error of said fiducial chip, as well as said image data representative of said image of said fiducial chip taken under the control of said fiducial-chip imaging control means.

10. An electric-component mounting system including (a) a component supply device for supplying an electric component, (b) a suction nozzle for holding said electric component by suction, (c) a circuit-substrate support device for supporting a circuit substrate, (d) a relative-movement device for moving said component supply device, said suction nozzle and said circuit-substrate support device, relative to each other, (e) a component-mounting control device for controlling said relative-movement device and said suction nozzle such that said electric component received by said suction nozzle from said component supply device is mounted at a predetermined position on said circuit substrate supported by said circuit-substrate support device, (f) a first image-taking device operable to take an image of said suction nozzle in a direction of extension to take an image of said suction nozzle in a direction of extension of a centerline of said suction nozzle, (g), a second image-taking device operable to take an image of a fidicial mark provided on said circuit substrate supported by said circuit-substrate support device, and (h) a data processing device for processing image data representative of said images taken by said first and second image-taking devices, said electric-component mounting system comprising:

at least one dog located such that an image of each of said at least one dog can be taken by said first image-taking device, together with said image of said suction nozzle;

image-taking control means controlling said first image-taking device to concurrently take said images of said suction nozzle and said at least one dog, and to concurrently take an image of a fiducial chip held by said suction nozzle and said image of said each dog;

positioning-error obtaining means for obtaining a relative position between said suction nozzle and said at least one dog, on the basis of said images of said suction nozzle and said at least one dog which have been concurrently taken under the control of said image-taking control means, said positioning-error obtaining a positioning error of said fiducial chip with respect to said suction nozzle, on the basis of said images of said fiducial chip and said at least one dog which have been concurrently taken, and said relative position between said suction nozzle and said at least one dog;

fiducial-chip mounting control means for moving said suction nozzle and said circuit-substrate support device, and placing said fiducial chip on a mounting surface which is disposed immovable relative to said circuit substrate support device;

fiducial-chip imaging control means for operating said second image-taking device to take said image of said fiducial chip place on said mounting surface;

relative-position obtaining means for obtaining relative positions among said suction nozzle and said first and second image-taking devices, on the basis of image data representative of said image of said fiducial chip, said fiducial-chip mounting control means being operable to compensate a relative position between said suction nozzle and said circuit-substrate support device for said positioning error of said fiducial chip with respect to said suction nozzle before said fiducial chip is placed on said mounting surface, or said relative -position obtaining means being operable to obtain said relative positions among said suction nozzle and said first and second image-taking devices on the basis of said positioning error of

said fiducial chip, as well as said image data representative of said image of said fiducial chip taken under the control of said fiducial-chip imaging control means;

fiducial-mark imaging control means for operating said second image-taking device to take an image of said fiducial mark provided on said circuit substrate supported by said circuit-substrate support device;

substrate-positioning-error obtaining means for obtaining a positioning error of said circuit substrate on the basis of image data representative of said image of said fiducial mark taken under the control of said fiducial-mark imaging control means;

electric-component imaging control means for operating said suction nozzle to hold said electric component, and operating said first image-taking device to take an image of said electric component held by said suction nozzle; and

mounting control means for compensating the relative position between said circuit-substrate support device and said suction nozzle, on the basis of image data representative of said image of said electric component, said relative positions among said suction nozzle and said first and second image-taking devices, and said positioning error of said circuit substrate obtained by said substrate-positioning-error obtaining means, so that said electric component is mounted at said predetermined position on said circuit substrate.

11. An electric-component mounting system according to claim 10, wherein said relative-movement device includes an X-axis slide movable in an X-axis direction in a plane parallel to a surface of said circuit substrate supported by said circuit substrate support device, and a Y-axis slide which is supported by said X-axis slide movably in said plane in a Y-axis direction perpendicular to said X-axis direction and which holds said suction nozzle, and said first image-taking device is fixedly disposed on said X-axis slide.

12. An electric-component mounting system according to claim 10, wherein said relative-movement device includes an X-axis slide movable in an X-axis direction in a plane

parallel to a surface of said circuit substrate supported by said circuit substrate support device, and a Y-axis slide which is supported by said X-axis slide movably in said plane in a Y-axis direction perpendicular to said X-axis direction and which holds said suction nozzle, and said first image-taking device is fixed to a stationary member which supports said X-axis slide.

13. An electric-component mounting system according to claim 10, wherein said relative-movement device includes an X-axis slide movable in an X-axis direction in a plane parallel to a surface of said circuit substrate supported by said circuit substrate support device, and a Y-axis slide which is supported by said X-axis slide movably in said plane in a Y-axis direction perpendicular to said X-axis direction and which holds said suction nozzle, and said second image-taking device is fixedly disposed on said Y-axis slide.

14. An electric-component mounting system according to claim 11, wherein said mounting surface includes a first mounting surface located at a first position near zero points of said X-axis slide and said Y-axis slide, and a second mounting surface located at a second position remote from said zero points of said X-axis slide and said Y-axis slide, and said fiducial-chip mounting control means is operable to place said fiducial chip on both of said first and second mounting surfaces.

15. An electric-component mounting system according to claim 10, wherein said relative-movement device includes an angular positioning device operable to turn said suction nozzle about a turning axis such that said suction nozzle is stopped at a plurality of working stations arranged along a path of turning of said suction nozzle, and an XY positioning device operable to move said circuit-substrate support device in mutually perpendicular X-axis and Y-axis directions in a plane parallel to a surface of said circuit substrate supported by said circuit- substrate support device, and said first image-taking device is fixedly disposed so as to be opposed to an end face of said suction nozzle stopped at one of said plurality working

stations, while said second image-taking device is fixedly disposed so as to be opposed to said circuit substrate supported on said circuit-substrate support device.

16. An electric-component mounting system according to claim 15, wherein said XY positioning device includes an X-axis slide movable in said X-axis direction, and a Y-axis slide movable in said Y-axis direction, and said mounting surface includes a first mounting surface located at a first position near zero points of said X-axis slide and said Y-axis slide, and a second mounting surface located at a second position remote from said zero points of said X-axis slide and said Y-axis slide, and said fiducial-chip mounting control means is operable to place said fiducial chip on both of said first and second mounting surfaces.